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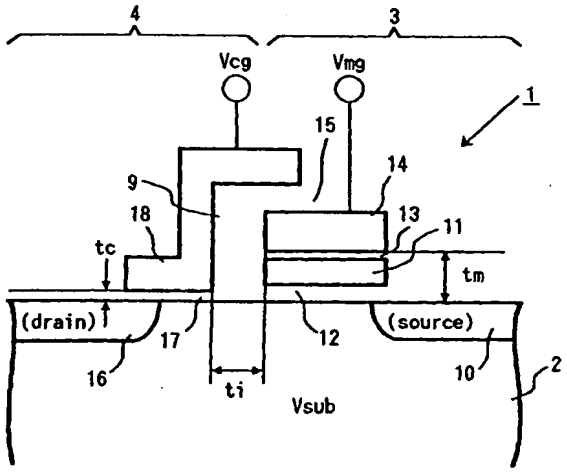
[続葉有]

(54) Title: SEMICONDUCTOR DEVICE

(54) 発明の名称: 半導体装置



(57) Abstract: A semiconductor device has nonvolatile memory cells (1), each of which comprising a MOS type first transistor section (3) used for information storage and a MOS type second transistor section (4) selecting a first transistor section. The second transistor section has a bit line electrode (16) connected to a bit line and a control gate electrode (18) connected to a control gate control line. The first transistor section has a source line electrode (10) connected to a source line, memory gate electrode (14) connected to a memory gate control line, and charge accumulating region (11) disposed just under the memory gate electrode. The gate dielectric strength of the second transistor section is lower than that of the first transistor section. When the thickness of the gate insulation film of the second transistor section is (tc) and that of the first transistor section is (tm), the relation of (tc)<(tm) holds.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/07371

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H01L29/788, 29/792, 27/115, 21/8247

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] H01L29/788, 29/792, 27/115, 21/8247

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Kokai Jitsuyo Shinan Koho	1971-2002	Toroku Jitsuyo Shinan Koho	1994-2002

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 5-82798 A (Fujitsu Ltd.), 02 April, 1993 (02.04.93), Full text; Fig. 1 (Family: none)	72,73,76 1-8,24-34, 36-39,88-91
X Y	US 6316317 B1 (NEC Corp.), 13 November, 2001 (13.11.01), Full text & JP 2000-269361 A Full text	71,75 1-8,24-34, 36-39,77
Y	JP 2001-44395 A (NEC Corp.), 11 December, 2001 (11.12.01), Full text & US 6329247 B1	1-8,24-34, 36-39

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 October, 2002 (22.10.02)	05 November, 2002 (05.11.02)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/07371

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2001-15613 A (Sony Corp.), 19 January, 2001 (19.01.01), Modes 3, 4; Figs. 4, 5 (Family: none)	7,8,48,49, 51,52,54,55, 57,58,60,61, 63,64,66,67
Y	JP 11-220044 A (Masaki OGURA), 10 August, 1999 (10.08.99), Par. Nos. [0072] to [0073]; Figs. 6A, 6B (Family: none)	27
X Y	US 2001/0000625 A1 (Kabushiki Kaisha Toshiba), 03 May, 2001 (03.05.01), Full text & JP 11-31799 A Full text	41-44,50,53, 56,59 30-33,40,45, 46-49,51,52, 54,55,57,58, 60-67,74
X Y	JP 11-177047 A (Hitachi, Ltd.), 02 July, 1999 (02.07.99), Full text & US 2002/9851 A & US 2002/14641 A & US 2002/19100 A	41-44,50,53, 56,59 30-33,40, 45-49,51,52, 54,55,57,58, 60-67,74
Y	JP 61-172375 A (Kabushiki Kaisha Toshiba), 04 August, 1986 (04.08.86), Full text; Figs. 5, 6 (Family: none)	34,37
Y	JP 10-22404 A (Ricoh Co., Ltd.), 23 January, 1998 (23.01.98), Full text; Figs. 2, 3 (Family: none)	40,47-49,51, 52,54,55,57, 58,60,61,63, 64,66,67,74, 88-91
X Y	JP 3-228377 A (Toshiba Corp.), 09 October, 1991 (09.10.91), Full text; Fig. 1 (Family: none)	68,69 70
X	JP 61-131484 A (Shingijutsu Kaihatsu Jigyodan), 19 June, 1986 (19.06.86), Full text; Fig. 1 (Family: none)	78
Y	JP 56-135973 A (Hitachi, Ltd.), 23 October, 1981 (23.10.81), Full text (Family: none)	84-87
Y	T.Y. LUO et al., Effect of H2 Content on Reliability of Ultrathin In-Situ Steam Generated(ISSG)SiO2, IEEE Electron Device Letters, Vol.21, No.9, September 2000, pages 430 to 432	88-91

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/07371

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 9-326487 A (Hitachi, Ltd.), 16 December, 1997 (16.12.97), Par. No. [0028] (Family: none)	79-83
A	JP 1-133364 A (Matsushita Electronics Corp.), 25 May, 1989 (25.05.89), Page 2, upper right column to lower left column (Family: none)	79-83

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/07371

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
The inventions of claims 1-23, 24-39 relate to the gate dielectric strengths of first and second MOS transistors which constitute memory cells.
The inventions of claims 40-67, 74, 86, 87, 91 relate to the thickness of the gate insulation film of the second MOS transistor and that of another MOS transistor which constitute memory cells.
The invention of claim 68 relates to the dielectric strength of the diffusion junction between the first MOS transistor and the second transistor which constitute memory cells.
(continued to extra sheet)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest
☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

Continuation of Box No.II of continuation of first sheet(1)

The inventions of claims 69, 70 relate to the structure of the diffusion layer of the second MOS transistor and that of another MOS transistor which constitute memory cells.

The inventions of claims 71, 75 relate to the charge neutral threshold value of first and second MOS transistors which constitute memory cells.

The inventions of claims 72, 73, 76, 77 relate to the channel impurity concentrations of the first and second MOS transistors which constitute memory cells.

The invention of claim 78 relates to the intergate distance, the distance between the gate and the storage holding regions of first and second MOS transistors which constitute memory cells.

The inventions of claims 79-83 relate to the gate oxide film of the second MOS transistor and the intergate insulation film of the first and second MOS transistors.

The inventions of claims 84, 85 relates to a semiconductor nonvolatile device having a nitride film with the function of locally holding charges formed by heat treatment in a hydrogen atmosphere.

The inventions of claims 88, 89 relate to the intergate insulation film of the first and second MOS transistors which constitute memory cells.

The invention of claim 90 relates to the gate insulation film of the first MOS transistor which constitutes a memory cell.